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CLAIMS

1. A method for conducting call fallback in a gateway, comprising:
 - receiving an incoming call;
 - establishing a Voice over IP (VoIP) call over a VoIP network;
 - generating audio packets from the incoming call and sending the audio packets over the VoIP call;
 - monitoring quality of service on the VoIP network during the VoIP call;
 - setting up a fallback call over a circuit switched network during the VoIP call when the monitored quality of service of the VoIP network degrades;
 - cross connecting the incoming call to both the fallback call and the VoIP call;
 - terminating midcall of the VoIP call after the fallback call has been setup;
 - redirecting the incoming call from the currently established VoIP call to the fallback call.
2. A method according to claim 1 including:
 - terminating the VoIP call;
 - continuing monitoring quality of service on the VoIP network during the fallback call;
 - establishing a new VoIP call during the fallback call when the quality of service of the VoIP network improves;
 - cross connecting the incoming call to both the fallback call and the new VoIP call when the new VoIP call is established;
 - sending audio packets encoded from the incoming call over the new VoIP call;
 - terminating the fallback call.
3. A method according to claim 2 including signaling that the incoming call is associated with the fallback call by identifying the fallback call in the audio packets of the audio packets sent over the new VoIP call.

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4. A method according to claim 1 including:

establishing the fallback call over either an ISDN fallback call having an outgoing ISDN channel or a DS0 fallback call having an outgoing PSTN DS0 channel;

5 receiving the incoming call over an incoming PSTN DS0 channel;

cross connecting the incoming call for a DS0 fallback call by cross connecting the incoming PSTN DS0 channel to the outgoing PSTN DS0 channel and then terminating the generation of audio packets from the incoming call;

10 cross connecting the incoming call for an ISDN fallback call by continuing generation of audio packets from the incoming call and rerouting the audio packets over the outgoing ISDN channel.

5. A method according to claim 1 wherein setting up the fallback call comprises:

15 detecting when the quality of service for the VoIP call has degraded below a predetermined level;

identifying any already established ISDN call with a same destination gateway as the VoIP call;

20 determining if the identified ISDN call has bandwidth capacity for carrying the VoIP call; and

using the ISDN call identified with sufficient bandwidth capacity as the fallback call for the VoIP call.

6. A method according to claim 1 including:

25 generating audio packets for multiple incoming calls;

setting up the fallback call as an ISDN connection;

cross connecting the audio packets for the multiple incoming calls over that same ISDN connection at the same time.

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7. A method according to claim 1 including:
receiving in an input buffer the audio packets from the VoIP call;
receiving audio signals from the fallback call and at the same time
receiving the audio packets from the VoIP call; and
5 disconnecting the VoIP call when the audio packets in the input buffer
have been played out.

8. A method according to claim 1 including:
receiving a new incoming call;
10 identifying any previously received incoming calls that are currently cross
connected over fallback calls to a destination gateway targeted for the new
incoming call; and
preventing the new incoming call from being established as a new VoIP
call when any previously received incoming calls are identified.

9. A method according to claim 1 wherein setting up the fallback call
includes sending signaling in the fallback call that associates the fallback call with
the VoIP call.

10. A method according to claim 9 wherein the signaling comprises
ISDN signaling, SS7 signaling or DTMF signaling.

11. A method according to claim 1 including:
sending time stamps in the audio packets of the VoIP call;
25 identifying a fallback call receive time when the fallback call is received at
a destination gateway;
comparing the packet time stamps with the identified fallback call receive
time; and
cross connecting the fallback call to an output of the destination gateway
30 when one of the time stamps converge with the fallback call receive time.

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12. A VoIP gateway, comprising:
a telephony interface for receiving an incoming call;
a VoIP interface for encoding the incoming call into audio packets;
and sending the audio packets over a VoIP network; and

5 a cross connect that sets up a fallback call over the telephone interface and
cross connects the incoming call to the fallback call at the same time that the
incoming call is being encoded into audio packets and sent over the VoIP call.

13. A VoIP gateway according to claim 12 wherein the cross connect
10 receives a quality of service measurement for the VoIP network and cross
connects the incoming call to the fallback call when the quality of service of the
VoIP network degrades.

14. A VoIP gateway according to claim 12 wherein the cross connect:
15 receives a termination signal back from a destination gateway to terminate
the VoIP call after audio signals from the incoming call has been received by the
destination gateway over the fallback call;

terminates the VoIP call by disabling the VoIP interface from encoding and
sending the audio packets from the incoming call over the VoIP network;

20 monitors the quality of service on the VoIP network during the fallback
call after the VoIP call has been terminated;

establishes a new VoIP call when the quality of service improves;
reenables the VoIP interface to encode and send audio packets from the
incoming call over the new VoIP call; and

25 terminates the fallback call after receiving confirmation from the
destination gateway that the audio packets are being received.

15. A VoIP gateway according to claim 12 wherein the fallback call is
established as an ISDN fallback call having an outgoing ISDN channel or an
30 outgoing PSTN DS0 fallback call having an outgoing PSTN DS0 channel.

16. A VoIP gateway according to claim 15 wherein:
the incoming call is received over an incoming PSTN DS0 channel;
the cross connect cross connects the incoming call directly to the outgoing
PSTN DS0 channel when the fallback call is the PSTN DS0 fallback call; and
5 the VoIP interface reroutes the audio packets encoded for the incoming call
to the outgoing ISDN channel when the fallback call is the ISDN fallback call.

17. A VoIP gateway according to claim 12 wherein the cross connect
establishes the fallback call over the telephony interface as follows:

10 detecting when the quality of service for the VoIP call has degraded below
a predetermined level;

identifying any existing ISDN fallback call on the telephony interface
currently established with a destination gateway that is also receiving the VoIP
call;

15 determining whether the existing ISDN fallback call has bandwidth
available for carrying the VoIP call;

using any identified ISDN fallback call with available bandwidth as the
fallback call for the VoIP call; and

20 establishing a new fallback call on the telephony interface when there is no
identified ISDN fallback call already established with the destination gateway
having available bandwidth capacity.

18. A VoIP gateway according to claim 15 wherein the telephony
interface receives multiple different incoming calls all directed to the same
25 destination gateway and the cross connect cross connects the audio packets for the
multiple different incoming calls over the same outgoing ISDN channel.

19. A VoIP gateway according to claim 12 wherein the cross connect
prevents any new incoming call from being sent over the VoIP network when any
30 fallback call is directed to a same destination gateway as the new incoming call.

20. A VoIP gateway, comprising:

a VoIP interface receiving audio packet from an incoming VoIP call, decoding the audio packets, and outputting the decoded audio packets to an outgoing telephony call;

a telephony interface for receiving a fallback call during the in-progress VoIP call and receiving signaling that associates the fallback call with the VoIP call; and

a cross connect that cross connects the fallback call to the outgoing telephony call of the associated VoIP call and drops the VoIP call after receiving audio signals over the fallback call.

21. A VoIP gateway according to claim 20 including a buffer for receiving the audio packets, the cross connect dropping the VoIP call after the VoIP interface has decoded all the audio packets in the buffer.

22. A VoIP gateway according to claim 20 wherein an operating system in the VoIP gateway monitors the quality of service of the VoIP network and sends a signal to an originating gateway to initiate the fallback call when the quality of service of the VoIP network degrades.

23. A VoIP gateway according to claim 20 wherein the cross connect:
sends a termination signal back to an originating gateway to terminate the
VoIP call after receiving a voice signal from the originating gateway through the
fallback call;

continues monitoring the quality of service on the VoIP network during the fallback call after the VoIP call has been terminated;

sends a request to the originating gateway to establish a new VoIP call when the quality of service of the VoIP network improves; and

terminates the fallback call after the new VoIP call has been established and VoIP packets from the new VoIP call have been received.

24. A VoIP gateway according to claim 20 wherein the fallback call is either an ISDN fallback call or a PSTN DS0 fallback call.

25. A VoIP gateway according to claim 20 wherein;
the fallback call contains audio packets;
the VoIP interface decodes the audio packets from the fallback call; and
the cross connect cross connects the decoded audio packets from the
fallback call to the telephony interface.

26. A VoIP gateway according to claim 20 wherein:
the telephony interface receives VoIP packets from multiple different incoming calls on the same fallback call;
the VoIP interface decodes the VoIP packets from the different incoming calls on the same fallback call; and
the cross connect cross connects the decoded audio packets from that same fallback call to different outputs on the telephony interface.

27. Computer software for use with a network processing device, said computer software:

detecting an incoming call;
initiating a Voice over IP (VoIP) call over a VoIP network for the incoming call that generates audio packets from the incoming call and sends the audio packets over the VoIP call;

monitoring quality of service on the VoIP network during the VoIP call;
initiating a fallback call over a circuit switched network during the VoIP call when the monitored quality of service of the VoIP network degrades;

cross connecting the incoming call to both the fallback call and the VoIP call during midcall of the VoIP call after the fallback call has been setup; and
redirecting the incoming call from the currently established VoIP call to the fallback call.

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28. Computer software according to claim 27 including:
initiating termination of the VoIP call;
maintaining monitoring quality of service on the VoIP network during the
fallback call;

5 initiating establishment of a new VoIP call during the fallback call when
the quality of service of the VoIP network improves;

cross connecting the incoming call to both the fallback call and the new
VoIP call when the new VoIP call is established, audio packets encoded from the
incoming call sent over the new VoIP call; and

10 initiating termination of the fallback call.

29. Computer software according to claim 28 including identifying the
new VoIP call with the fallback call using headers in the audio packets sent over
the new VoIP call.

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30. Computer software according to claim 27 including:
initiating establishment of the fallback call over either an ISDN fallback
call having an outgoing ISDN channel or a DS0 fallback call having an outgoing
PSTN DS0 channel;

20 detecting receipt of the incoming call over an incoming PSTN DS0
channel;

cross connecting the incoming call for a DS0 fallback call by cross
connecting the incoming PSTN DS0 channel to the outgoing PSTN DS0 channel
and then terminating the generation of audio packets from the incoming call; and

25 cross connecting the incoming call for an ISDN fallback call by continuing
generation of audio packets from the incoming call and rerouting the audio
packets over the outgoing ISDN channel.

31. Computer software according to claim 27 wherein setting up the
30 fallback call comprises:

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detecting when the quality of service for the VoIP call has degraded below a predetermined level;

identifying any already established ISDN call with a same destination gateway as the VoIP call;

5 determining if the identified ISDN call has bandwidth capacity for carrying the VoIP call; and

using the ISDN call identified with sufficient bandwidth capacity as the fallback call for the VoIP call.

10 32. Computer software according to claim 27 including:

generating audio packets for multiple incoming calls;

setting up the fallback call as an ISDN connection;

cross connecting the audio packets for the multiple incoming calls over that same ISDN connection at the same time.

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